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Cholera was not epidemic, attacks being 2 and deaths 2 during the week. Both cases were imported, 1 from Kathiawar, in the province of Gujerat, and 1 from Elephanta, an island 7 miles away, across the harbor. Out of 83 plague cases, 5 were imported.

Transactions during the week ended December 17, 1904.

Sanitary certificate No. 65 (accompanying consular invoice No. 285 of 1904) and sanitary certificate No. 66 (accompanying consular invoice No. 286 of 1904) were issued on December 15, 1904, each for 4,000 baskets of onions shipped per steamship *Ischia* to Manila. The onions were grown at Lonaud, on the highlands of the Deccan, a place free from cholera.

Abstract of a paper on plague, rats, and fleas. By Capt. Glen Liston, M. D.

Plague is a rat disease which, under favoring circumstances, is not infrequently communicated to man. The disease may, therefore, be said to be accidental and certainly avoidable if there be a distance between rats and men. The idea that rats play the most important part in the spread of plague is no new one, for it was recognized by the ancients as well as by more recent authorities. If it is a rat's disease, then it is likely that the disease has its own distinct laws of origination and continuance among these animals. Such a study has been neglected. We must know more about the life and habits of rats, so far as these have a bearing on the spread of plague. There are two species of domestic rats: *Mus decumanus*, the common rat found in Europe, a burrowing rodent living in drains and cellars; and *Mus rattus*, the common rat of Bombay and the East generally, living often in the roofs of houses, and even in trees. The latter is more truly a domestic rat. Plague might rage as an epizootic among rats of the species *Mus decumanus* and man would have little chance of infection, but an epidemic of plague among rats of the species *Mus rattus* is very liable to be communicated to man.

The species of rat affected with plague has an important bearing on the spread of the disease in man, not from any inherent difference in the susceptibility to the disease in the particular disease, but because of the habits of the species. The disappearance of plague from Europe was coincident with the invasion of that continent by the brown rat and the displacement, by that species, of the black rat. While the habits of the black rat played an important part in the spread of plague, the habits of men encouraged or discouraged the prevalence of this species of rat. In Europe the brown rat displaced the black rat as solid buildings became erected, as drainage systems were developed, as stables were separated from dwelling houses, as shops, warehouses, and granaries were no longer used as human habitation. As stone and wooden floors displaced mud and rush-covered ground, as beds became used in place of heaps of straw, so the black rat was driven from his haunts, and the brown rat had it all his own way. Man and rats were separated from one another and plague ceased to trouble, for man played an important part in spreading the disease among rats. Rats, like men, are gregarious in their ways, with their quarters for the poor and

the well to do, some living on the refuse of the people and others installing themselves in the granaries of the rich.

There is little communication between these communities in the same village or town, and there must be still less communication between the rats of one town and those of another, except through human agency. Ships, railways, and roads, the means of conveyance of merchandise, are also the means by which rats are taken from one town to another, the rats being carried as "stowaways." This being a chance means of communication, the larger the means of transport the greater the chance; hence ships transfer rats more frequently than railway trains. Another habit of rats that has an important bearing on the spread of plague is their habit of migrating as a community when scared by an unusual mortality among themselves. In this habit they resemble man. Under these circumstances plague can be spread from one rat community to another rat community in the same town, and a fresh focus of infection set up. Further, the breeding season of rats plays an important part in the spread of plague, because (1) the number of susceptible individuals is increased, (2) the number of fleas (the transmitters of infection) is also greatly multiplied.

If plague is a rat disease, how is it communicated to man? As in the case of certain plants, reproduced by the means of intermediate hosts, so in the case of plague, the flea is the intermediate host. The plague bacillus finds in the flea's stomach a daily supply of the very food it requires, viz, animal blood. It is not acted on by the digestive juices of the flea, and is there securely protected from light, desiccating and other bacteria which act on the plague bacillus as weeds do on a delicate plant. The flea, however, being animate, not only affords favorable soil for the growth of plague bacilli, but transfers them by its bite to the animal body. The various species of fleas, with their own particular habits, require study. Flea-ridden animals often have their own characteristic flea. Rat fleas are seldom found on man, and the question therefore naturally arises as to how plague can be conveyed from rat to man or from man to rat by means of fleas. It depends on the migration of rats in the presence of an unusual mortality among themselves. They leave their fleas behind, to a large extent, and these in sheer hunger attack man and other animals. Experimental proof of this was seen in the case of an epidemic among guinea pigs and in the case of an outbreak of plague in a chawl (tenement house) in Bombay. While normally rat fleas are never found on guinea pigs, in the above case they swarmed on them, 18 being found on one sick guinea pig alone.

Under normal conditions the writer has found 1 rat flea on man among 246 human fleas. But in the case of the chawl referred to above, of 30 fleas caught on man, no less than 14 were rat fleas. Considering the experimental methods of plague infection in animals, we know that one or two bacilli are able to kill an animal if introduced by a hypodermic needle, while millions would be necessary by any other method. Which, then, would be likely to be the most common mode of infection? Granted that infection generally occurs through the skin, there is a mass of evidence against the introduction of the bacillus through accidental cuts and abrasions, and everything points to a definite hypodermic introduction of the virus by such an insect as the flea. The seasonal and endemic prevalence of plague may be

explained in terms of the habits of rats and fleas. Infection in neighboring towns and villages is chiefly conveyed by man to rats by means of rat fleas carried on clothing. There are many other facts in the epidemiology of plague which can be explained in no other way than by assuming the flea to be the carrier of infection; such facts, for instance, as the notorious infectivity of houses, particularly at night, and the efficacy of oil and tobacco as preventives against plague. As to preventive measures against plague, as it seems impossible to place a distance between rats and man except by years of sanitary improvement and education, the only method that holds out any hope of salvation now and until sanitary reforms are carried out is to acquire immunity to plague by inoculation.

Reports from Calcutta—Fumigation of vessels—Cholera and plague mortality.

Acting Assistant Surgeon Eakins reports, December 8 and 15, as follows:

During the week ended December 3, 1904, bill of health was issued to the steamship *Scharzfels*, bound to Boston and New York, with a total crew of 63, and to the steamship *Terje Viken*, bound to Philadelphia, with a total crew of 44 or 47. The usual precautions were taken, holds fumigated, rat guards placed on wharf lines, and Lascars' effects disinfected.

During the week ended December 3, 1904, there were 69 deaths from cholera and 8 deaths from plague in Calcutta.

In Bengal, during the week ended November 29, 1904, there were 492 cases of and 421 deaths from plague.

During the week ended December 10, 1904, bill of health was issued to the steamship *Hohenfels*, bound to Boston and New York, with a total crew of 63. The usual precautions were taken, rat guards placed on wharf lines, and Lascars' effects disinfected.

During the week ended December 10, 1904, there were 72 deaths from cholera and 12 deaths from plague in Calcutta.

In Bengal, during the week ended December 3, 1904, there were 938 cases and 735 deaths from plague.

In India, during the week ended November 26, 1904, there were 18,488 cases and 14,528 deaths from plague.

Increase in plague in Upper India.

With the advance of the cold weather plague is again growing worse in Upper India. Last week, December 3, the United Provinces had 4,425 deaths, an increase of 1,000 on the total of the previous week; the Punjab 2,446, an increase of 400; Mysore 1,157, an increase of nearly 600; Hyderabad State 768, an increase of 200. In the Bombay Presidency there were 6,770 deaths, an increase of 300. Elsewhere throughout India the disease remains about as before. The total for the entire country last week was 17,728 deaths. This is 3,000 more than the previous 7 days and 1,000 in excess of the returns of the corresponding week of last year.